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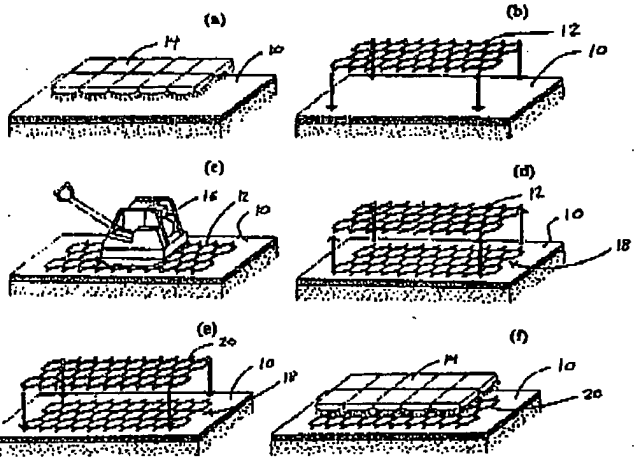
(54) Title: METHOD OF FORMING AN INLAID PATTERN IN AN ASPHALT SURFACE



(57) Abstract: In one embodiment the method comprises the steps of providing a first template having a predetermined pattern; impressing the first template into the asphalt surface when the asphalt surface is in a pliable state to form an impression therein; removing the first template from the asphalt surface to expose the impression; providing a second template having a predetermined pattern matching the pattern of the first template; inserting the second template into the impression; and fixing the second template in position within the impression to form the inlaid pattern. The second template may consist of a preformed thermoplastic grid having a color and/or texture contrasting with the asphalt surface. In another embodiment the second template may include a light source for illuminating the template after it has been fixed in position. A heating method is described for gradually heating large asphalt surfaces using a reciprocating bank of infrared heaters to thermally fix the thermoplastic grid in place.

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METHOD OF FORMING AN INLAID PATTERN IN AN ASPHALT SURFACE

Technical Field

[0001] This application relates to a method of forming an inlaid pattern in an asphalt surface. The pattern may be selected for functional or decorative purposes.

Background

[0002] Various methods for forming patterns in asphalt surfaces are known in the prior art. The Applicant is the owner of United States Letters Patent No. 5,215,402 which describes a method of forming a pattern in an asphalt surface using a removable template. The template is compressed into a pliable asphalt surface to imprint a predetermined pattern simulating, for example, the appearance of bricks, cobblestones, interlocking paving stones or the like. The template is then lifted clear of the asphalt surface and the asphalt is allowed to harden. A thin layer of a cementitious coating may be applied to the imprinted asphalt to enhance the brick and mortar or other desired effect.

[0003] In the above-described method the template does not remain inlaid within the asphalt surface. The visual effect is created by the combination of the imprinted pattern and the decorative coating. One drawback to this method is that the decorative coating may wear off over time, particularly in high traffic areas.

[0004] It is known in the prior art to install traffic markings on asphalt surfaces. However, such markings typically project above the asphalt surface. In regions receiving frequent snowfalls during the winter months traffic markings may be removed or damaged by snowplow usage.

[0005] Another known method for producing traffic markings involves grinding grooves in asphalt surfaces and then pouring into the grooves a hot molten material which is allowed to set in place. However, this is a very time consuming procedure and is not well suited for forming complicated patterns or covering large surface areas.

[0006] The need has therefore arisen for improved methods and materials for inlaying patterns in asphalt surfaces.

Summary of Invention

[0007] In accordance with the invention, a method of forming an inlaid pattern in an asphalt surface is disclosed. The method includes the steps of:

(a) providing a first template having a predetermined pattern;

(b) impressing the first template into the asphalt surface when the asphalt surface is in a pliable state to form an impression therein;

(c) removing the first template from the asphalt surface to expose the impression;

(d) providing a second template having a predetermined pattern matching the pattern of the first template;

(e) inserting the second template into the impression; and

(f) fixing the second template in position within the impression to form the inlaid pattern.

[0008] The method may include the step of heating the asphalt surface in situ at the impression site prior to impressing the first template into the asphalt surface.

[0009] The step of fixing the second template in position within the impression comprises heating the second template to cause the second template to bond to the asphalt surface. For example, the second template may be heated to a temperature within the range of about 100° F - 400° F and more preferably within the range of 150° F - 350° F.

[0010] The second template may comprise a pre-formed thermoplastic grid of unitary construction. The color of the grid may be selected to contrast with the color of the asphalt surface. In another embodiment the grid may include a light source for lighting the grid once it has been set in place in the asphalt surface. In other embodiments the grid may be luminescent or flourescent, such as when subjected to light of a suitable wavelength. In one embodiment the first and/or second templates may include a plurality of frame elements defining open areas therebetween, the open areas comprising approximately 50 - 90% of the total surface area of each template.

[0011] In one embodiment the second template may comprise an upper surface which is substantially flush with the surface of the asphalt when the second template is fixed in position. Alternatively, a portion of the second template may be raised above the asphalt surface or recessed below the asphalt surface when it is set in place.

[0012] The second template may be formed from a plurality of frame elements each having a relatively narrow width to facilitate compression of the template into the asphalt surface. For example, the frame elements may have a width between ¼ inch and 4 inches.

[0013] In a further alternative embodiment the asphalt surface may be heated in situ and the template may be compressed into the asphalt surface directly while the asphalt is in a pliable state and without deforming the desired predetermined pattern. The template is then fixed in place as in the embodiment described above. Templates adapted for impression forming and inlaid applications are described herein.

[0014] In one aspect of the invention a method of forming an inlaid pattern in an asphalt surface is described comprising:

(a) gradually heating the asphalt surface in situ until it is in a pliable state by periodically passing an infrared heater thereover;

(b) forming an impression in the asphalt surface;

(c) introducing a settable material into the impression; and

(d) allowing the settable material to set within the impression to form the inlaid pattern.

In another aspect of the invention the method of forming an inlaid pattern comprises:

(a) forming an impression in the asphalt surface;

(b) placing a thermoplastic template into the impression; and

(c) gradually heating the thermoplastic template by periodically passing at least one heater thereover until the template adheres to the asphalt surface.

The heater is preferably a reciprocating infrared heater capable of heating a relatively large surface area, such as greater than 10 square feet, while permitting visual monitoring of the work site. For example, a heating apparatus having a frame extendable over the asphalt surface may be provided and the infrared heater(s) may reciprocate on the frame to gradually heat the asphalt surface and/or the inlaid template.

Brief Description of Drawings

[0015] In drawings which illustrate embodiments of the invention, but which should not be construed as restricting the spirit or scope of the invention in any way,

[0016] Figure 1(a) is a perspective view of a portable heater for pre-heating an asphalt surface;

[0017] Figure 1(b) is a perspective view of a first template defining a predetermined pattern for imprinting an asphalt surface;

[0018] Figure 1(c) is a perspective view of the first template being forcefully compressed into the asphalt surface using a compaction apparatus;

[0019] Figure 1(d) is a perspective view of the first template being lifted clear of the asphalt surface to expose an impression having the predetermined pattern;

[0020] Figure 1(e) is a perspective view of a second template having a pattern matching the pattern of the first template and showing the second template being lowered into the impression formed in the asphalt surface;

[0021] Figure 1(f) is a perspective view of a portable heater for re-heating the asphalt surface to fix the second template in position within the impression;

[0022] Figure 2(a) is a perspective view of a portable heater for pre-heating an asphalt surface as in Figure 1(a);

[0023] Figure 2(b) is a perspective view of a template defining a predetermined pattern and suitable for direct compression into the asphalt surface;

[0024] Figure 2(c) is a perspective view of the template of Figure 2(b) being forcefully compressed into the asphalt surface using a compaction apparatus without deforming the predetermined pattern;

[0025] Figure 2(d) is a perspective view of a portable heater for re-heating the asphalt surface to fix the second template in position;

[0026] Figure 3 is a perspective view of a template of Figures 1 and 2;

[0027] Figure 4(a) is a diagrammatic side elevational view of the method of Figure 2 wherein the template is delivered from a spool mounted on a vehicle having a drum roller; and

[0028] Figure 4(b) is a plan elevational view of the method of Figure 4(a).

[0029] Figure 5 is perspective view of an apparatus comprising reciprocating infrared heaters for gradually heating a template inlaid in an asphalt surface.

[0030] Figure 6 is an end elevational view of the reciprocating heaters of Figure 5.

[0031] Figure 7 is a graph showing the gradual increase in the asphalt surface temperature with successive passes of the reciprocating heaters of Figure 5.

Description

[0032] Throughout the following description, specific details are set forth in order to provide a more thorough understanding of the invention. However, the invention may be practiced without these particulars. In other instances, well known elements have not been shown or described in detail to avoid unnecessarily obscuring the invention. Accordingly, the specification and drawings are to be regarded in an illustrative, rather than a restrictive, sense.

[0033] With reference to the drawings, this application relates to methods and apparatus for imprinting an asphalt surface 10. As used in this patent application "asphalt" means a paving compound for constructing roads, driveways, walkways and the like which consists of a combination of bituminous binder, such as tar, and an aggregate, such as sand or gravel.

[0034] As shown in Figure 1(b), a first template 12 is provided for imprinting a predetermined pattern in asphalt surface 10. The predetermined pattern may serve a specific function, such as a crosswalk marking, or it may be purely decorative. In the illustrated embodiment first template 12 comprises a flexible grid defining a plurality of open areas (Figure 3). However, it should be appreciated that the structure of first template 12 may vary without departing from the invention. For example, template 12 may have a flat, continuous top surface and a plurality of projections formed on its bottom surface arranged in the desired pattern.

[0035] Template 12 is compressed into asphalt surface 10 when surface 10 is in a pliable state. For example, template 12 may be compressed into hot, freshly rolled asphalt (which is typically on the order of 150° - 400° F depending upon the type of ashpalt). Alternatively, a portable surface heater 14 may be provided (Figure 1(a)) for preheating a preexisting asphalt surface 10 to a pliable state. As used in this patent application the term heating "in situ" refers to heating a pre-existing asphalt surface at the work site rather than using hot asphalt heated off-site.

[0036] Template 12 may be compressed into surface 10 with a mechanical compactor, such as a vibrating plate compactor 16 or a drum roller (Figure 1(c). After template 12 has been compressed into asphalt surface 10, it is removed to expose an impression 18 in the desired pattern (Figure 1(d)). For example, impression 18 may consist of a plurality of channels or simulated grout lines. By way of another example, impression 18 may be the outline of a corporate logo or decorative design.

[0037] The next step in the process is to provide a second template 20 configured to fit within impression 18. As shown in Figure 1(e)), second template 20 preferably has a shape and layout matching at least

partly the pattern of first template 12. In one embodiment of the invention second template 20 may match the pattern of first template 12 (and hence impression 18) exactly. In an alternative embodiment of the invention, second template 20 may partially but not completely match the pattern of first template 12. In this case second template 20 partially fills impression 18 when it is inlaid within asphalt surface 10.

[0038] Second template 20 is positioned within impression 18 as shown in Figure 1(e). If necessary, the impressed asphalt surface 10 may be reheated before positioning template 20 within impression 18. In one embodiment of the invention second template 20 may consist of a preformed grid formed from a thermoplastic material. A suitable thermoplastic material is available from Lafarge Road Markings and is sold under the trademark THERMALINE™. Rubber, plastic or other materials suitable for inlaying in asphalt surface 10 could also optionally be employed. Template 20 may have a color and/or texture designed to contrast with asphalt surface 10. In one possible arrangement the depth of template 20 is less than or equal to the depth of impression 18 so that template 20 does not extend above the plane of asphalt surface 10 when it is inlaid in position. This could an advantage, for example, in the case of traffic markings which may be slippery and hence potentially hazardous to motorists and bicyclists if not inlaid. In another possible arrangement, the depth of template 20 exceeds that of impression 18 so that template 20 is raised above the plane of asphalt surface 10 when set in position. In this latter arrangement template 20 is both visually and tactilely distinquishable from asphalt surface 10. This may be useful, for example, in regulating the speed of vehicles traversing a paved roadway or the like.

[0039] In one embodiment of the invention templates 12 and 20 are formed from a plurality of frame elements 13 which are relatively narrow in width and are arranged in a grid (Figure 3). This ensures that such

templates can be readily compressed into asphalt surface 10. Also, in high traffic areas, frame elements 13 of relatively narrow width are less subject to wear. For example, frame elements 13 may have a width less than the width of a standard automobile tire. A width size between ¼inch and 4 inches is suitable for many applications. Ordinarily frame elements 13 will not be less than ¼inch in width to ensure that they are readily visible once template 20 is fixed in position (although they may be some applications where very narrow frame elements 13 could be employed). Also, there are applications where very wide frame elements 13 or templates 12, 20 having continuous surfaces could be employed as discussed further below.

[0040] The thickness of frame elements 13 is also variable depending upon the application. The preferred thickness range is between 20 - 160 mil with 40 - 130 mil being the most preferred range. If the frame elements are very thin template 20 will be overly fragile. Conversely, if frame elements 13 are too thick templates 12, 20 will be difficult to compress into place. The optimum size and dimensions of frame elements 13 may depend in part on the pliability of asphalt surface 10 (i.e. whether the asphalt is relatively coarse or mastic in composition)

[0041] As shown in Figure 3, frame elements 13 of templates 12, 20 may define a plurality of open areas 15. In one embodiment of the invention open areas 15 comprise approximately 50 - 90% of the total surface area of templates 12, 20. Conversely closed areas defined by frame elements 13 comprise approximately 10 - 50% of the total surface area of templates 12, 20. The above ratios facilitate impression of templates 12, 20 into asphalt surface 10 using a conventional roller or plate compactor 16. For example, each frame element 13 could be ½ inch wide and the spaces between elements 13 could be 3 ½ wide. The total surface area of the template 12, 20 could be 4 square feet (i.e. 2' X 2'). Using a

standard plate compactor 16, downward compressive force will applied to frame elements 13 only and hence the effective compressive force (i,e. pounds per square inch of frame elements 13) will be sufficient to readily compress template 12 or 20 into surface 10. However, if the ratio of closed areas to open areas as defined above is increased by substantially increasing the width of frame elements 13, then the effective compressive force per surface area of frame elements 13 will be correspondingly reduced. Accordingly, a larger compactor 16 having a higher compressive force rating may be required to impress templates 12, 20 into asphalt surface 10. It is advantageous to manufacture templates 12, 20 which can be readily compressed using commonly available equipment. In one suitable embodiment the total closed surface area of template 12, 20 underlying compactor 16 may be approximately 10 - 50% of the surface area of the plate portion of compactor 16 which applies a compressive force (Figure 1(c)).

[0042] The final step in the installation procedure is to fix second template 20 in position within impression 18. In the embodiment illustrated in Figure 1(f), portable surface heater 14 is passed over the surface of second template 20 after it has been positioned within impression 18 to reheat surface 10. If template 20 is formed from a thermoplastic material as described above, this causes template 20 to flow into the interstices of impression 18 thereby enhancing adhesion to asphalt surface 10. Once template 20 is fully seated within impression 18, heater 14 is removed and template 20 is allowed to set in place. Alternatively template 20 may be pre-heated prior to its placement within impression 18 to facilitate template seating. Depending upon the material used, the second template 20 may be pre-heated or heated in situ to a temperature within the range of 100° - 400° F, or more particularly 150° - 350° F.

[0043] Another possible means for fixing template 20 within impression 18 is by the use of conventional glue adhesives. For example, impression 18 could be coated with a glue adhesive prior to the placement of template 20 therein. The step of fixing template 20 in position could therefore include applying the glue and allowing the glue sufficient time to set. Alternatively template 20 may comprise a tear-off layer which may be removed on site to expose an adhesive surface capable of bonding to asphalt surface 10.

[0044] In one possible embodiment of the invention, template 20 may consist of reflective material suitable for designating pedestrian crosswalks, turning lanes and the like. In another embodiment template 20 may include a light source or LED display for illuminating template 20 in its inlaid position, such as for safety or decorative purposes. Similarly, template 20 may be formed from flourescent material or material which is luminescent when subjected to light of a suitable wavelength (such as ultraviolet light). In another embodiment template 20 may be constructed from a skid-resistant material.

[0045] After template 20 has been inlaid, asphalt surface 10 may optionally be treated with a clear protective sealer. For example, the sealer could be formulated to protect surface 10 from oxidization and moisture damage, thereby preventing premature aging and discoloration of the patterned surface. The sealer could be an acrylic sealer commonly used in other applications to coat cementitious substrates.

[0046] In an alternative embodiment of the invention shown in Figure 2 second template 20 may be compressed directly into asphalt surface 10 without first forming an impression 18 using first template 12. In order for this alternative method to work effectively asphalt surface 10 must be sufficiently pliable such that template 20 will not deform from the desired

pattern when it is compressed into surface 10. As in the embodiment discussed above, surface 10 may be preheated in situ to a pliable state (Figure 2(a). As shown in Figures 2(b) and 2(c), template 20 is then compressed directly into surface 10. Surface 10 is then reheated after template 20 is in position to fix template 20 in place (Figure 2(d)).

[0047] Figures 4(a) and 4(b) illustrate apparatus useful for carrying out the alternative method of the invention described above in an automated fashion. In the illustrated embodiment first template 20 is sufficiently flexible that it may be wound around a spool 22 mounted on a vehicle 24. Vehicle 24 also includes a drum roller 26 for progressively compressing template 20 into asphalt surface 10 as template 20 is unwound from spool 22. Portable surface heaters 14 move in advance of and behind vehicle 24 to pre-heat and re-heat the asphalt surface.

[0048] As will be apparent to a person skilled in the art, in an alternative embodiment of the invention template 12could be provided on a drum roller rather than being a physically separate apparatus. That is, the means for forming impression 18 in asphalt surface 10 could be a surface contacting portion of compressive apparatus 16 itself. However, template 20 must be capable of being separated from compressive apparatus 16 since it remains inlaid within impression 18 as described above and shown, for example, in Figure 4(a).

[0049] Figure 5 illustrates a further alternative embodiment of the invention. In this embodiment a mobile heating apparatus 30 is provided as the portable surface heater 14. Apparatus 30 includes elongated rails 32 which are supported above asphalt surface 10 by support legs 34 and housing 36. A heater truck 38 is provided for reciprocating movement on rails 32. Truck 38 supports a bank of infrared heaters 40 at positions close to asphalt surface 10 (e.g. approximately 2 inches above the ground).

[0050] As shown in Figures 5 and 6, in operation infrared heaters 40 travel back and forth over asphalt surface 10 to gradually heat surface 10 and template 20 inset therein. For example, template 20 may be formed from a thermoplastic material as described above. Heaters 40 may be used to heat template 20 to a temperature sufficient to fix template 20 in place within a surface impression 18 (Figures 1(e) and 1(f)).

[0051] In one embodiment heaters 40 move through three cycles per minute (each cycle being a traversal of truck 38 from housing 36 to the distal end of rails 32 and back again). An important advantage of the heating method of Figure 5 is that a relatively large surface area of asphalt 10 can be heated gradually and evenly. This approach avoids the disadvantages of hand-held torch heaters which cannot easily be used to evenly heat large areas and have a tendency to scorch the thermoplastic material and/or the asphalt. For example, depending upon its composition, asphalt can scorch when subjected to sustained temperatures above approximately 325°F. Figure 7 is a graph showing the changing temperature profile of asphalt surface 10 with successive passes of heaters 40. Surface 10 is allowed to cool after each heating cycle. The temperature of surface 10 (and template 20 in-laid therein) gradually increases with successive heating cycles until the desired temperature suitable for thermoplastic/asphalt adhesion is achieved. The asphalt surface is subjected to a relatively slow heat soak to permit heat to gradually penetrate below the uppermost surface layer.

[0052] Further, heating apparatus 30 allows the operator to visually monitor the work site during the heating operation. For example, in use templates 20 may be manufactured in mats approximately 2' by 2' in size for ease of handling. Multiple templates 20 may be arranged to cover a large surface area. The templates 20 could be arranged so that the frame

elements 13 (Figure 3) of adjacent templates are partially overlapping at the joinder sites. The gradual heating method described above could be continued until the overlapping frame elements melt together and adhere. Heating apparatus 30 allows the operator to visually monitor this process to avoid underheating or overheating.

[0053] As will be appreciated by a person skilled in the art, the gradual heating method shown in Figures 5 - 6 could be used to facilitate adherence of thermoplastic or other settable markings to any comparatively large asphalt surface 10, such as adherence of in-laid or projecting traffic markings. One advantage of this approach in comparison to conventional painted-on traffic markings is that the installation process is not weather dependent. Also the marking would not become obliterated by wear of the surface layer (i.e. since the marking color would extend consistently throughout the thickness of the marking).

[0054] In a further embodiment of the invention, the applicant's method could be employed to form an inlaid pattern in asphalt surface 10 wherein only the edge portion(s) of the template or other inlaid marking are inlaid. For example, a thermoplastic inlaid traffic marking having a gently curved upper surface could be provided. An impression 18 could be formed in surface 10 conforming to the contour of the periphery of the marking. Impression 18 could be formed so that only edge portions of the marking are inlaid to ensure that the edges will not be caught by snow plows in regions having winter snowfalls. Further, the curvature of the traffic marking could enhance the reflectivity of the thermoplastic material to improve traffic safety.

[0055] In one embodiment of the invention the gradual heating method of Figures 5 - 6 could be used to heat comparatively large thermoplastic surfaces, such as corporate logos, traffic markings,

pedestrian walkways, driveways or the like. In this embodiment the grid-like thermoplastic template 20 could be replaced by continuous thermoplastic sheets formed in the desired shape and pattern. As in the embodiment described above, it is important to heat the thermoplastic material gradually and evenly to achieve optimum adhesion to the underlying asphalt surface 10. In this embodiment heaters 40 would primarily heat the thermoplastic material to promote adhesion although some ancillary heating of the surrounding asphalt surface could also occur. In this embodiment the thermoplastic sheets may not be inlaid but may nevertheless be gently heated as described above to adhere to the underlying asphalt substrate.

[0056] In still further alternative embodiments of the invention heating apparatus 30 may be modified to include one or more heat sensors for sensing the temperature of asphalt surface 10. The heat sensors could be mounted on truck 38 to travel over surface 10 and scan the temperature thereof. Apparatus 30 may also include a controller for switching off one or more of the heaters 40 in the heater bank depending upon the measured surface temperature. For example, once the surface temperature achieves a target value, some of the heaters 40 could be switched off to prevent further heating and possible scorching of the asphalt while other heaters 40 could remain on to maintain the surface temperature at or near the target value.

[0057] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

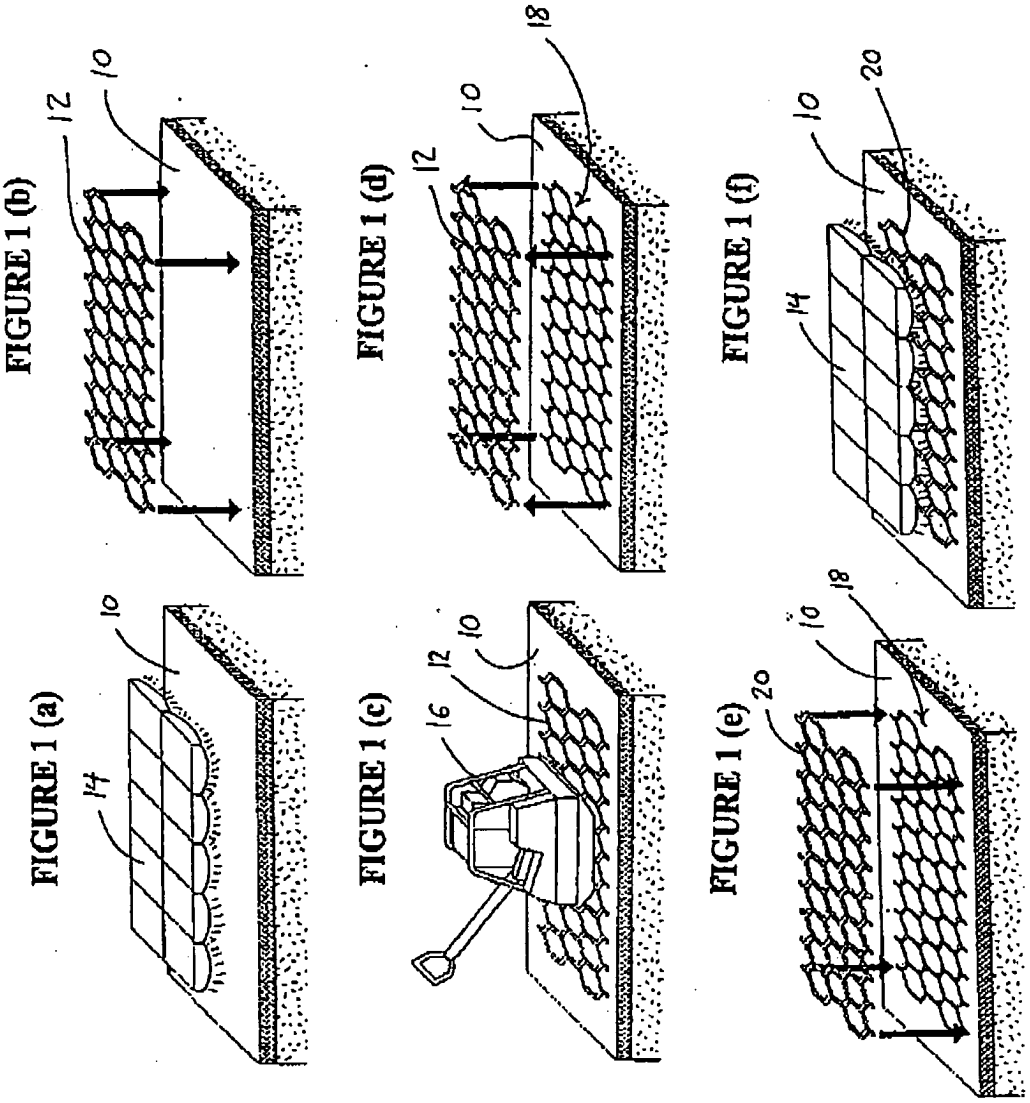


FIGURE 1 (a)
10
14
FIGURE 1 (b)
12
10
FIGURE 1 (c)
12
10
16
FIGURE 1 (d)
18
10
12
FIGURE 1 (e)
20
10
18
FIGURE 1 (f)
20
10
14

FIGURE 2 (b)

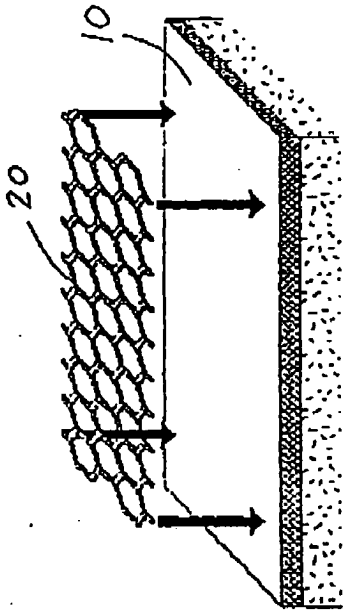


FIGURE 2 (d)

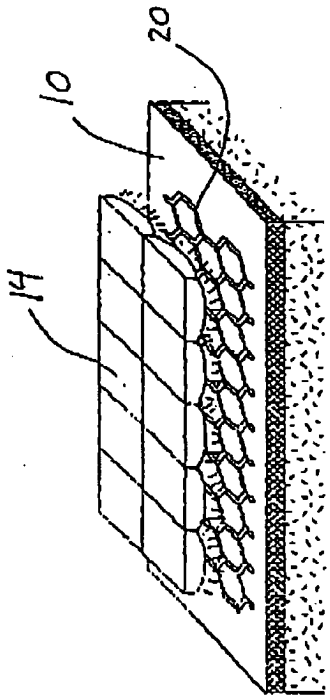


FIGURE 2 (a)

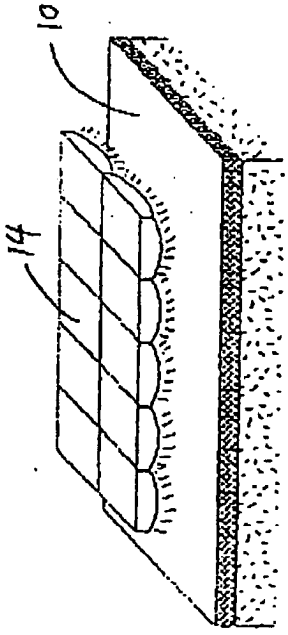
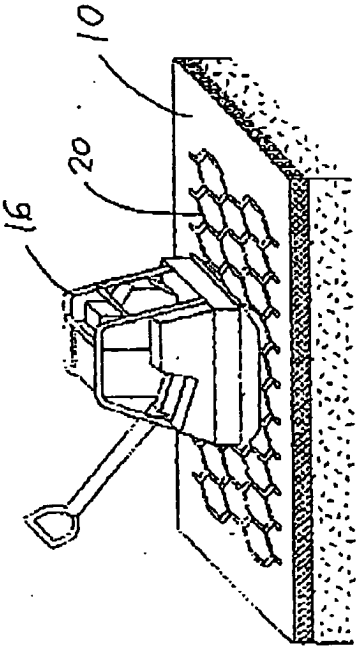


FIGURE 2 (c)



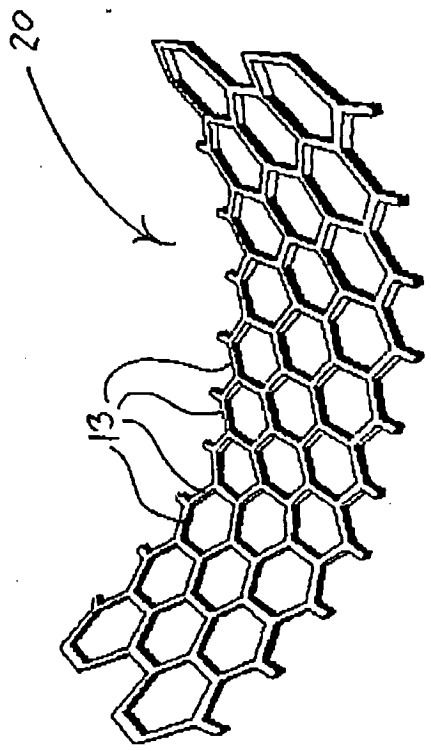


FIGURE 3

FIGURE 4 (a)

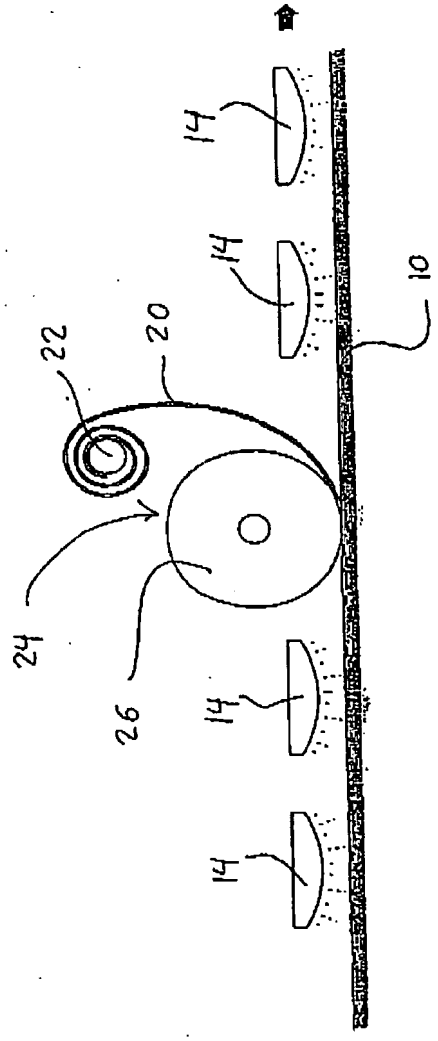
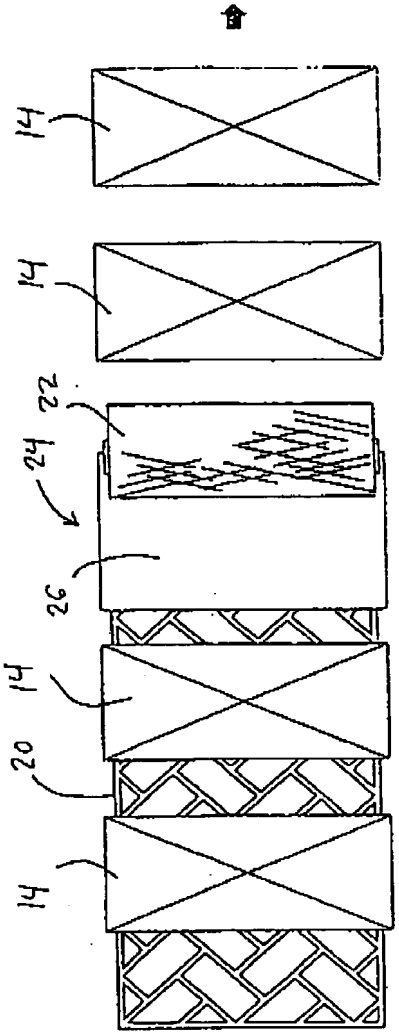


FIGURE 4 (b)



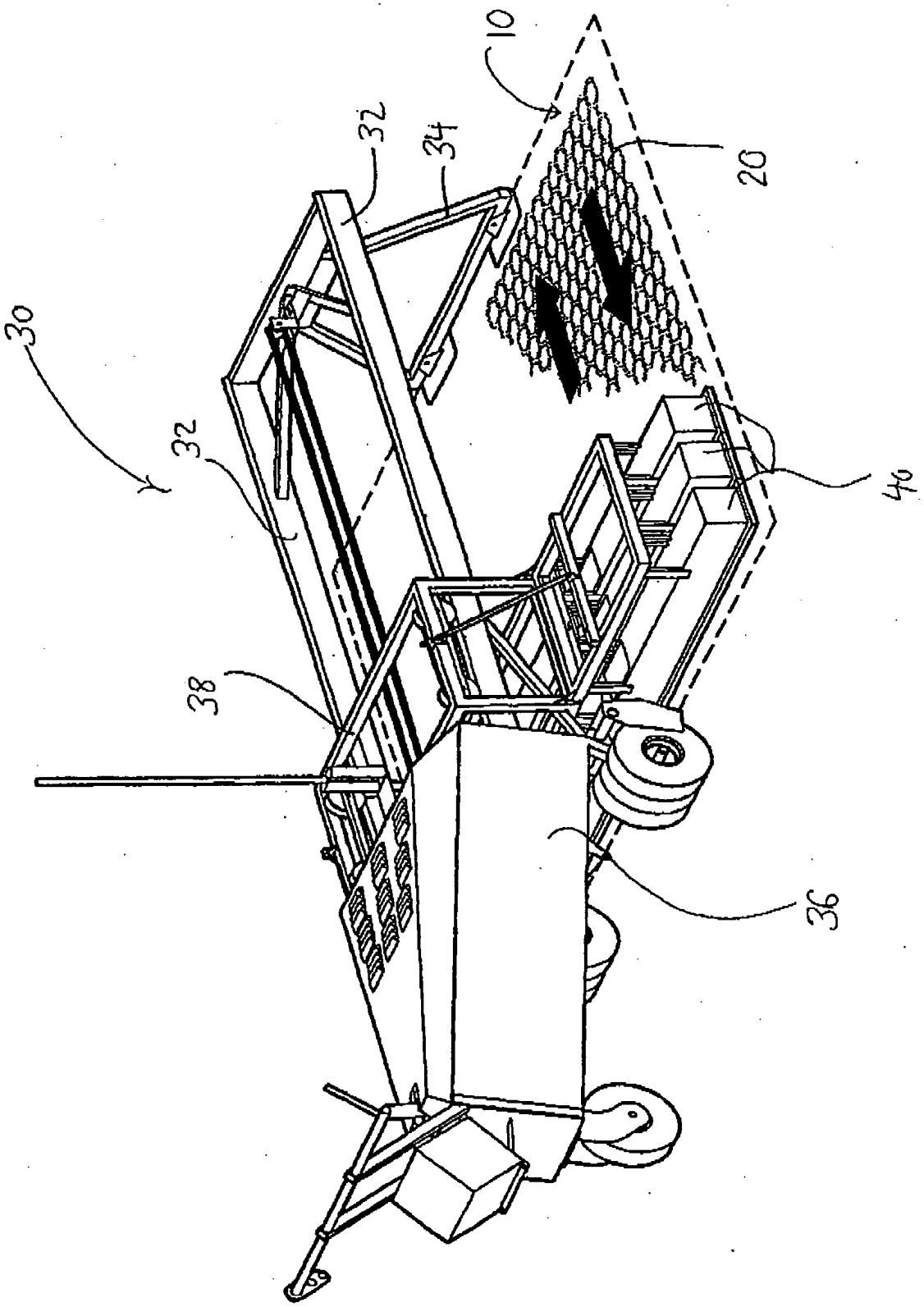


FIGURE 5

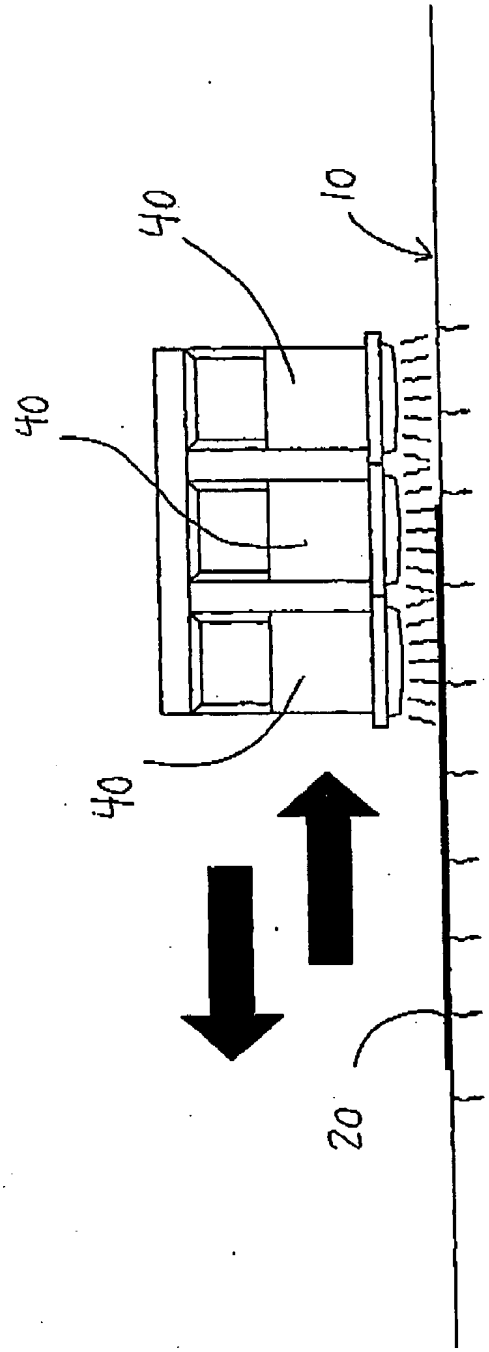


FIGURE 6

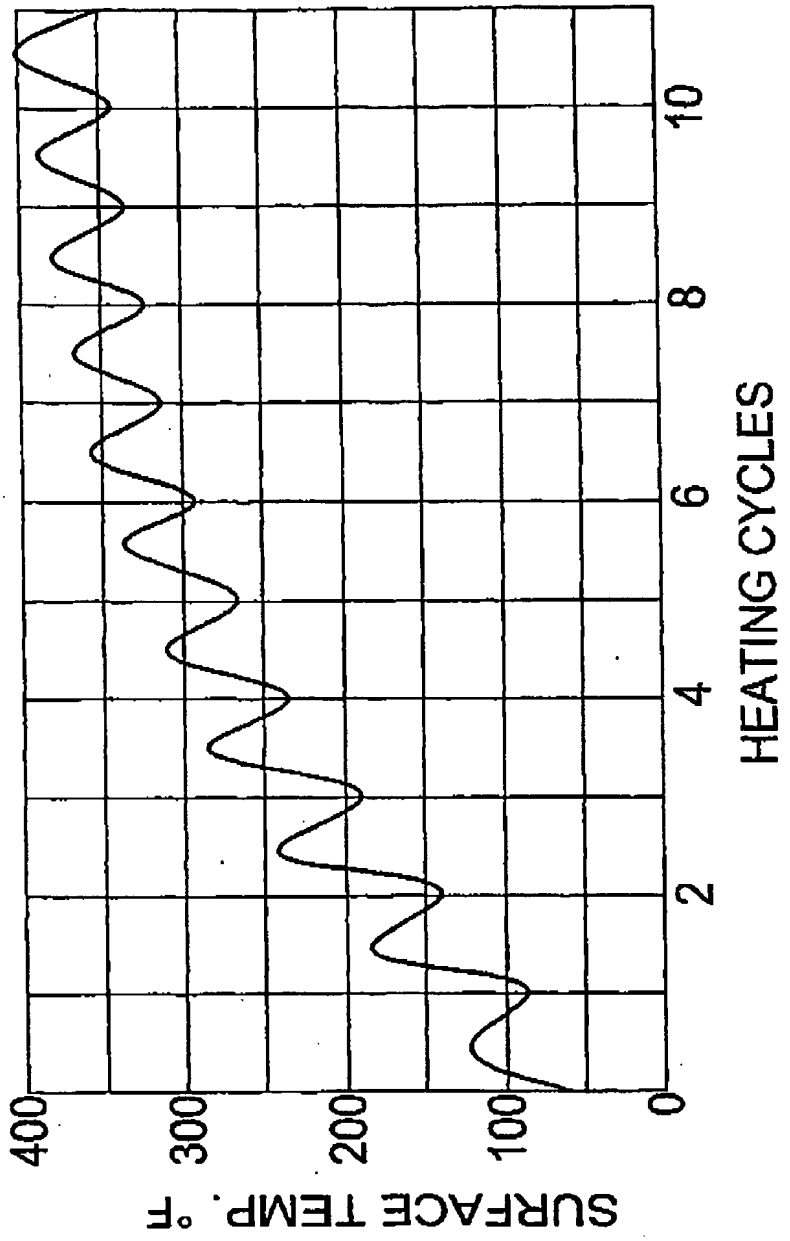


FIGURE 7